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Research on the Relationship between Fire Rescue Event Density and Location Based on Kriging Interpolation Model

Zhenyang Li, Wenbo Zhang

Nanjing Institute of Technology, School of Electric Power Engineering, Jiangsu, Nanjing, 211167

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Abstract: With the development of China's socialist market economy, profound changes have taken place in many aspects of our social economy and management system. The fire department also performs administrative law enforcement functions and provides safety services for economic and social development. Firstly, the relative coordinates of each region are solved in the coordinate system according to the adjacent relationship and distance map between each region. Then, the event density is solved according to the relevant data, the spatial complexity of event density is solved by using Floyd algorithm graph theory, the data is visualized, and the spatial distribution map of event density is given. Finally, the Kriging interpolation model is established, the fitting equation between event density and location is constructed, and the spatial correlation of event density is analyzed.

1. Introduction

In the new round of institutional reform, the fire brigade has been collectively transformed into a comprehensive standing emergency backbone, which is a key step towards professionalization in the construction of China's fire rescue force system. How to better improve our fire rescue team system and enhance its ability to deal with all kinds of natural disasters and emergency disasters has become a major practical issue in the new era.

This paper analyzes the spatial correlation of various event densities from 2016 to 2020, and gives the event categories with the strongest correlation in different regions. Firstly, the relative coordinates of each region are solved in the coordinate system according to the adjacent relationship and distance map between each region. Then, the event density is solved according to the relevant data, the spatial complexity of event density is solved by using Floyd algorithm graph theory, the data is visualized, and the spatial distribution map of event density is given. Finally, the Kriging interpolation model is established, the fitting equation between event density and location is constructed, and the spatial correlation of event density is analyzed.

2. Model Establishment and Solution

2.1 Floyd algorithm graph theory model

Floyd algorithm is a classical dynamic programming algorithm. The goal is to find the shortest path from point i to point j. The shortest path from any node i to any node j is no more than two possibilities, one is directly from i to j, and the other is from i through several nodes k to j. Therefore, we assume that dis (i, j) is the shortest path distance from node u to node v. for each node k, we check whether dis (i, k) + dis (k, j) < dis (i, j) is true. If it is true, it is proved that the path from i to k and then to j is shorter than the path from i to j directly, so we set dis (i, j) = dis (i, k) + dis (k, j). In this way, when we traverse all nodes k, dis (i, j) the distance of the shortest path from i to j is recorded in.

2.2 Kriging interpolation model

2.2.1 Model introduction:

Kriging interpolation, also known as spatial local interpolation, is a method for unbiased optimal estimation of regionalized variables in limited areas based on variogram theory and structural analysis. The scope of application is that the regionalized variables have spatial correlation, that is, if the results of variogram and structural analysis show that the regionalized variables have spatial correlation, Kriging interpolation can be used for interpolation or extrapolation. It is based on the shape, size and spatial orientation of sample points, the spatial relationship with unknown sample points, and the structural information provided by variogram, a linear unbiased optimal estimation of position samples.

2.2.2 Model preparation

The event density is solved through analysis:

Table 1: Event density

①	0.000810	0.000607	0.000523	0.000972	0.000864	0.001175	0.000679	0.000619	0.000184	0.001037	0.000581	0.000150	0.000484	0.000560	0.067805
②	0.000256	0.000096	0.000044	0.000460	0.000138	0.000045	0.000068	0.000247	0.000031	0.000674	0.000087	0.000060	0.000193	0.000215	0.019373
③	0.000938	0.000511	0.000610	0.001279	0.002177	0.001130	0.001120	0.000454	0.000307	0.001451	0.000930	0.000689	0.001612	0.001292	0.091052
④	0.000810	0.000224	0.000392	0.000665	0.000311	0.000407	0.000645	0.000454	0.000184	0.000622	0.000291	0.000420	0.000387	0.000258	0.049595
⑤	0.000043	0.000000	0.000087	0.000102	0.000069	0.000090	0.000102	0.000082	0.000000	0.000052	0.000000	0.000090	0.000097	0.000000	0.007362
⑥	0.000128	0.000064	0.000000	0.000102	0.000104	0.000045	0.000068	0.000000	0.000031	0.000415	0.000058	0.000180	0.000193	0.000043	0.090278
⑦	0.003708	0.002238	0.002354	0.004245	0.004803	0.004021	0.003972	0.002475	0.001504	0.003784	0.003284	0.001438	0.003997	0.001894	0.310353
该地各类事件密度求和	0.006691	0.003740	0.004010	0.007825	0.008466	0.006913	0.006653	0.004331	0.002240	0.008035	0.005231	0.003027	0.006963	0.004262	0.635817

2.2.3 Model establishment and solution

Establish a coordinate system, convert the relative position relationship into the relative coordinates under the plane coordinate system, use matlab to establish the Kriging interpolation model, and create a 40 * 40 grid with a marking range of 0-100, that is, the grid spacing is 0.5. S stores the point coordinate values, YX draws the interpolation surface map for the event density, and then uses the original scattered point data to draw the interpolation error of each point.

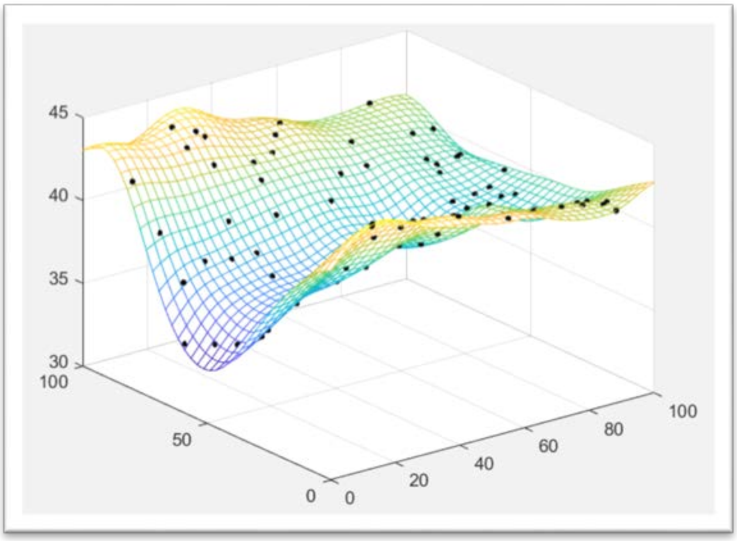

Figure 1: Interpolation surface

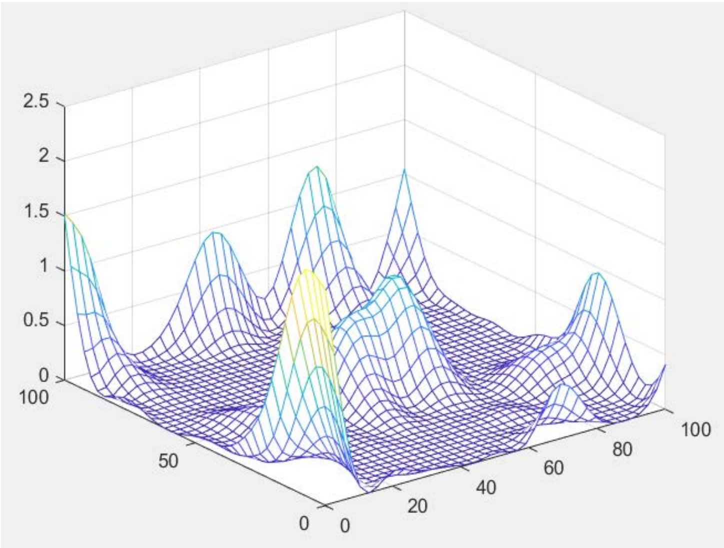

Figure 2: Fitting error value (root mean square error)

2.2.4 Spatial correlation analysis of event density

For event ①: The event density is the largest in region G and the lowest in region L.
For event ②: The event density is the highest in region M and the lowest in region I.
For event ③: The event density is the largest in region P and the lowest in region I.
For event ④: The event density is the largest in region P and the lowest in region I.
For event ⑤: The event density in region P is the largest and the lowest in region B, I, K, M, N.
For event ⑥: The event density in region P is the largest and the lowest in region C and H.
For event ⑦: The event density is the largest in region P and the lowest in region L.
The analysis shows that ③④⑤⑥⑦ events have high spatial correlation in region P .
For region A and H: ③ ⑦ events have the strongest correlation.
For region B: ① ⑦ events are most relevant.

For region C, J, K, L: ① ③ ⑦ events are most relevant.
For region D, E, F, G, I, M, N: ③ ⑦ events have the strongest correlation.
For region P: ① ③ ⑥ events have the strongest correlation.

3. Model Evaluation

This paper uses Floyd algorithm graph theory to calculate the shortest distance between any two nodes. Using Kriging interpolation model, not only the relationship between the location of evaluation points and known data, but also the spatial correlation of variables is considered.

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